
Photo:Josh Noble

Development of Water Quality Standards for Willard Spur

Overview of Science Panel Discussion

October 28, 2015 Meeting

Meeting Objectives

- **Review Conditions and form a consensus around an answer to this question:**
  - *What are the potential impacts of the Perry Willard Regional Wastewater Treatment Plant on Willard Spur?*

Meeting Agenda

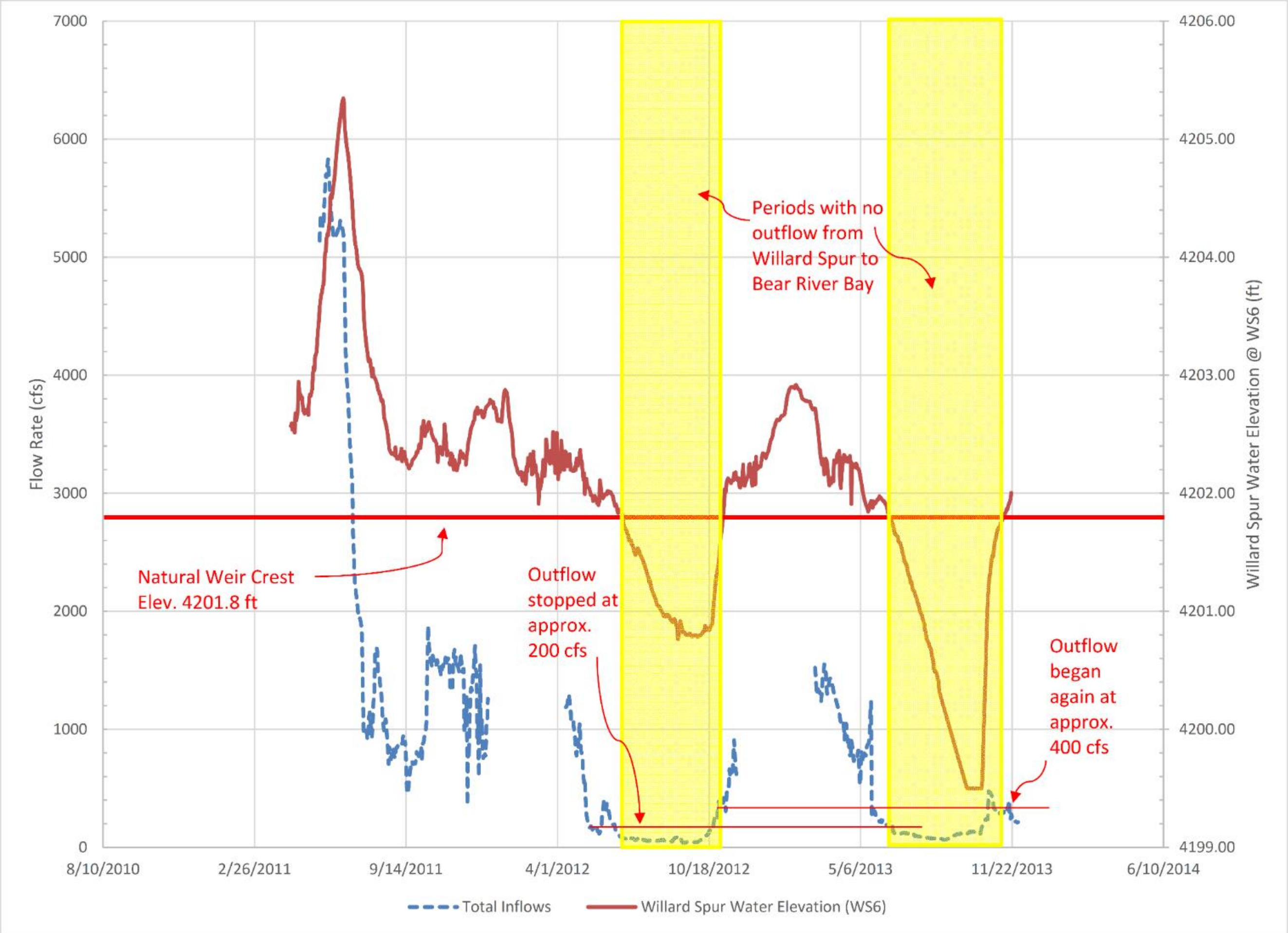
- **What is the current condition of Willard Spur?**
  - Hydrology & Nutrient Loads
  - Food Web
  - Open Water Characteristics
  - Nutrient Cycling
- **Does Willard Spur currently support its beneficial uses?**

Meeting Agenda

- **Did the Plant's effluent discharge degrade the Willard Spur ecosystem**
  - Was there an impact?
- **What are the potential impacts of the Perry Willard Regional Wastewater Treatment Plant on Willard Spur?**
  - **What is the risk of Future impacts?**

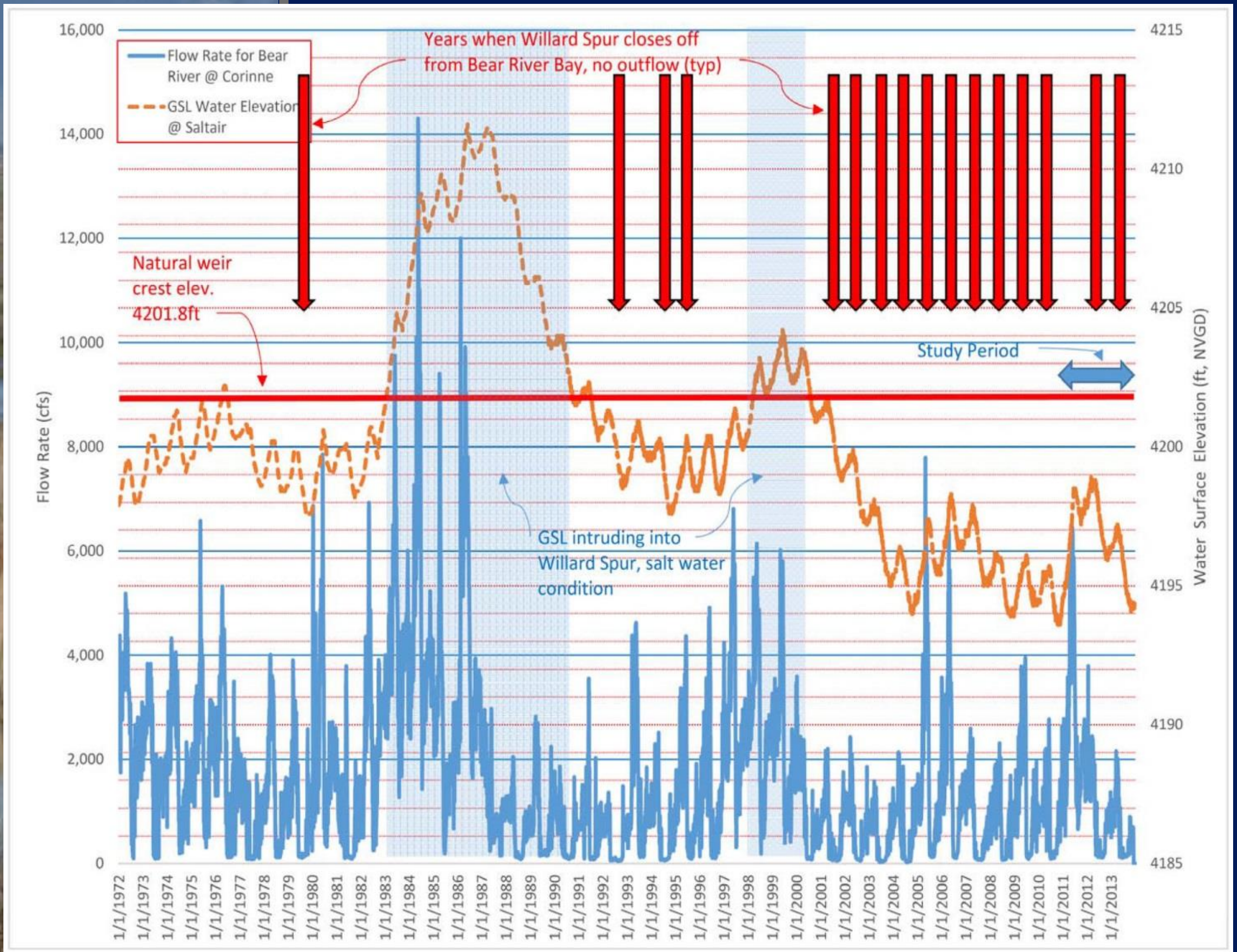
Hydrology & Nutrient Loads

Key Observations - Hydrology



- **Typical Cycle is Key**
  - Small peak in February-March
  - Spring runoff peak in April – June
  - Sharp reduction in inflow in May – September
  - Impounded from July - September
  - Increase in and sustained inflow in October - January

Key Observations - Hydrology



- **Typically two flow regimes per year**
  - Flowing and impounded, controlled by natural weir
  - "Flushing" flows from October-May seem to reset clock

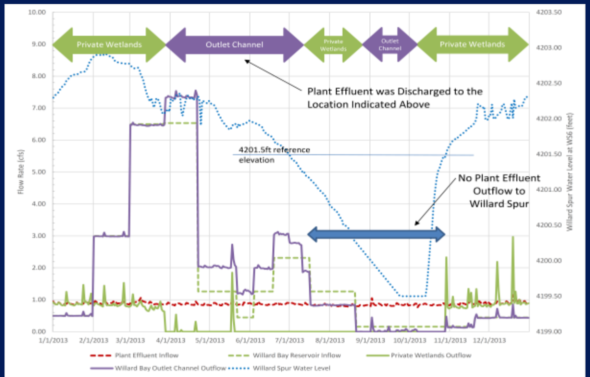
Key Observations - Hydrology

- **Water Balance indicated significant groundwater interaction**
  - Infiltrating inflows
  - Maintaining pool elevation
  - Recharging prior to outflow to Bear River Bay
  - Two unknowns; difficult to define

Reflects multi-annual cycle

Key Observations - Hydrology

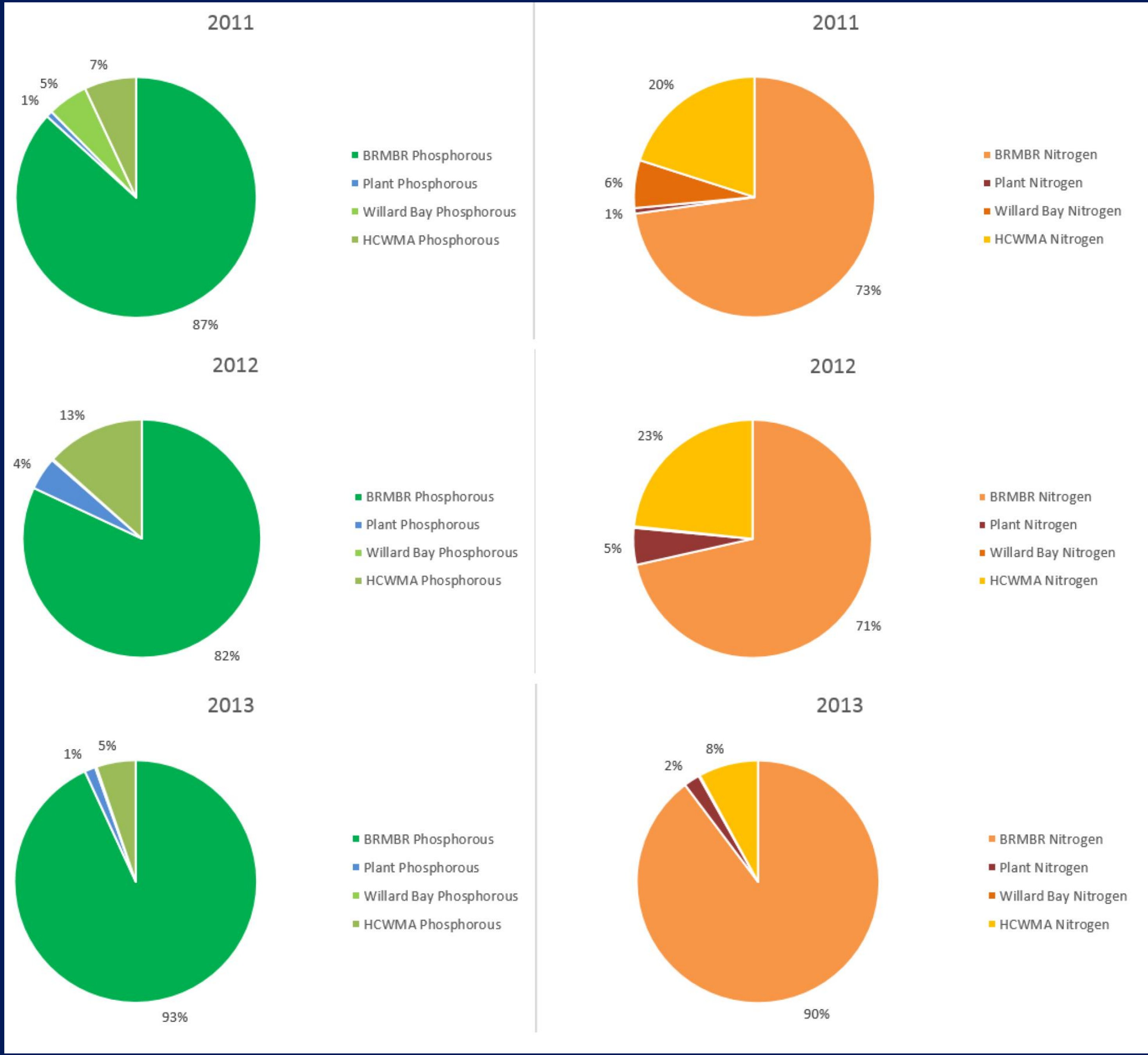
- **Plant's effluent did reach the open water; but, it depended upon:**
  - Location of discharge
  - Time of year
  - Water level in Willard Spur
  - Groundwater interaction



- **Flushing flows appear to be a significant factor in reducing the risk of nutrient accumulation/impacts**

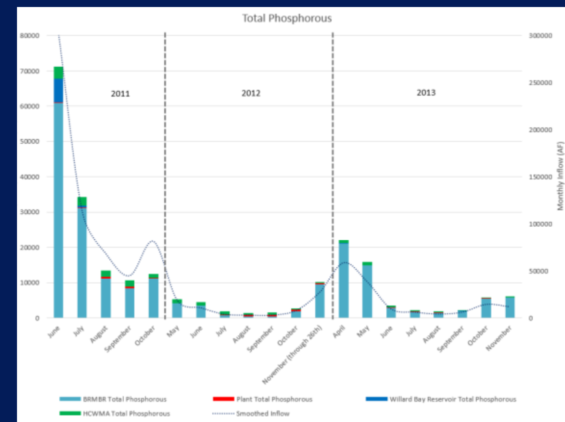
Key Observations – Nutrient Loads

- **BRMBR was primary source of nutrient inputs, followed by HCWMA**
  - Together represent 90-100% of nutrient input
- **Plant was typically <5% of the nutrient input**
  - Contribution to total budget increased as percentage during summer but actual load reaching open water during this period was negligible


2011
7%
5%
1%
87%
BRMBR Phosphorous
Plant Phosphorous
Willard Bay Phosphorous
HCWMA Phosphorous
2011
20%
6%
1%
73%
BRMBR Nitrogen
Plant Nitrogen
Willard Bay Nitrogen
HCWMA Nitrogen
2012
13%
4%
82%
BRMBR Phosphorous
Plant Phosphorous
Willard Bay Phosphorous
HCWMA Phosphorous
2012
23%
5%
71%
BRMBR Nitrogen
Plant Nitrogen
Willard Bay Nitrogen
HCWMA Nitrogen
2013
1%
5%
93%
BRMBR Phosphorous
Plant Phosphorous
Willard Bay Phosphorous
HCWMA Phosphorous
2013
8%
2%
90%
BRMBR Nitrogen
Plant Nitrogen
Willard Bay Nitrogen
HCWMA Nitrogen

Key Observations – Nutrient Loads

- **Seasonal loading tracked with inflow hydrographs**



  - Higher during spring runoff and winter flows → Dispersed, diluted, assimilated, exported
  - Low in summer, not certain how much of this load reached the open water → Retained, assimilated, but then flushed

Food Web

What are we trying to protect?

Which spur is the real spur?

Key Observations – Bird Use

- **56 species identified using Willard Spur**
- **Bird species & use correlated to water level**
  - More shorebirds during impoundment
  - More waterbirds during flowing conditions
- **Results in high diversity of bird species & use patterns**

Key Observations – Bird Use

- **Strong links between**
  - Water level and habitat dynamics
  - Habitat and available food
  - Water level and bird use

Key Observations – Fish Use

- Fish are present
- Closely linked to upstream fisheries
- Dominated by fish more tolerant of extremes

Key Observations – Macroinvertebrates & Zooplankton

- **Similar in composition and response to other GSL wetlands**
- **Abundance and composition varies seasonally**
  - Water level and presence of SAV
- **Highly resilient even after drought**

Key Observations - Vegetation

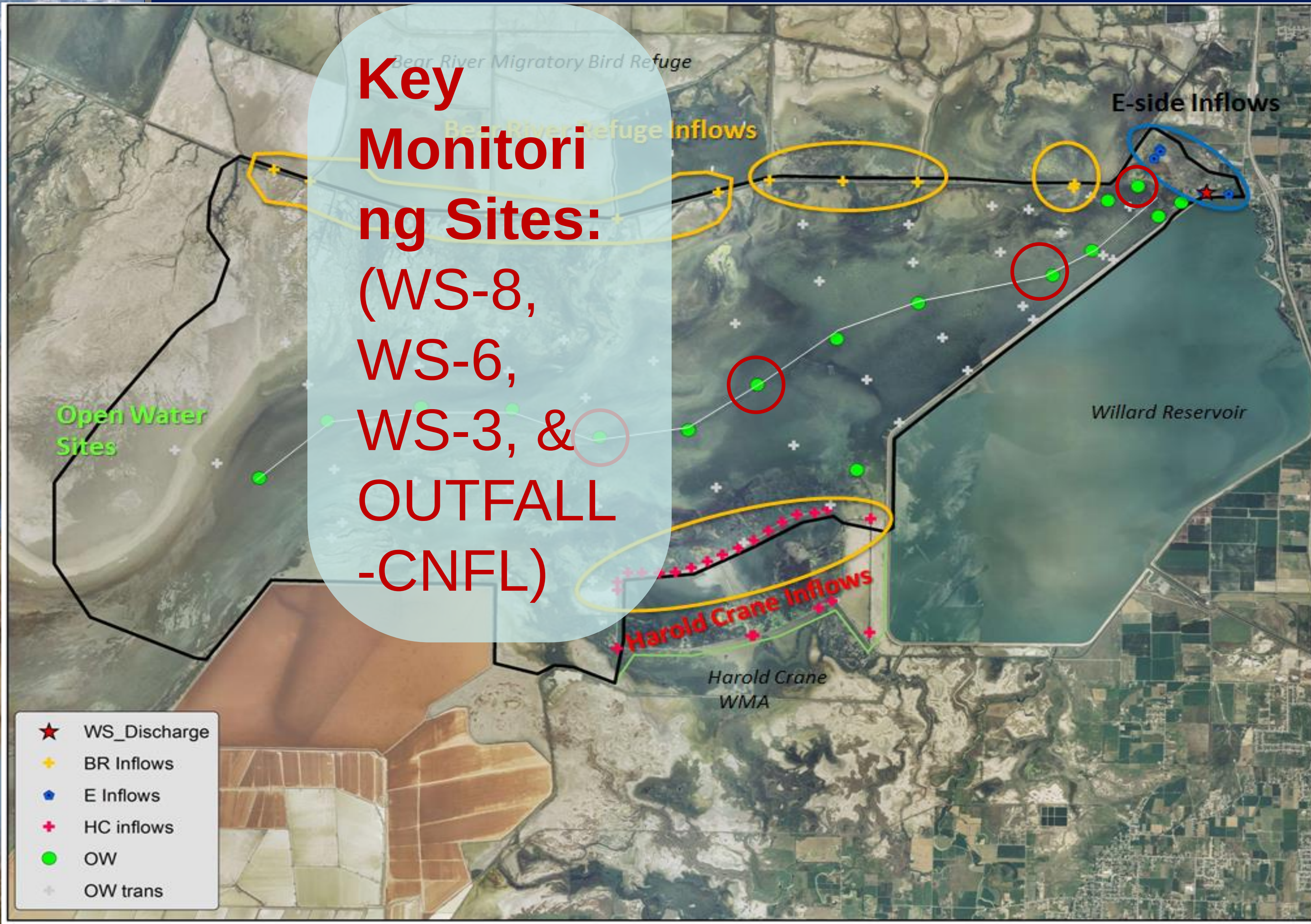
- **Vegetation are a critical element of the habitat**
- **Linked closely to freshwater inflows, water levels, and salinity**
- **Observed increase in *phragmites* is of concern**
  - Potential link to nutrients

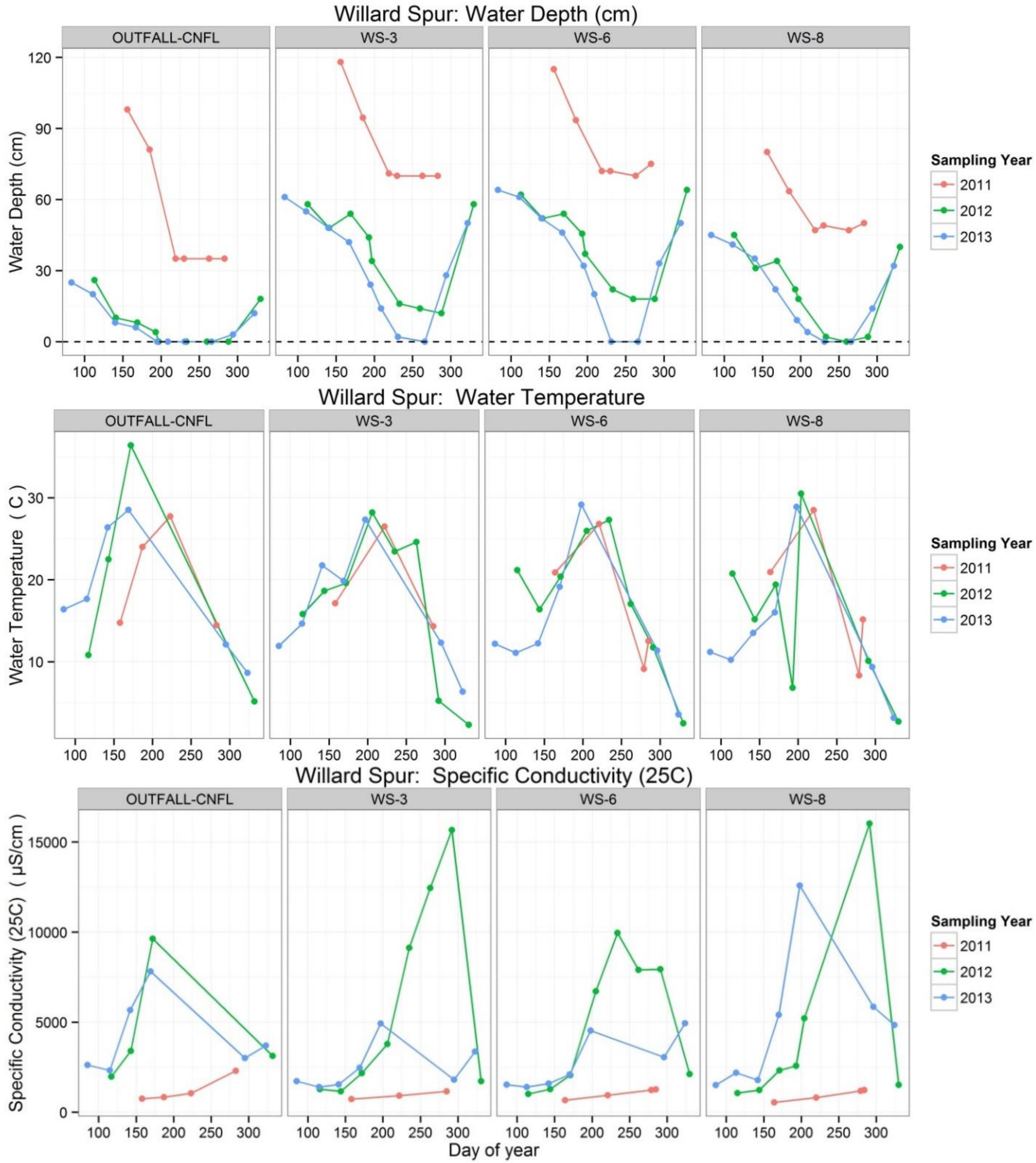
Conclusions

- Highly dynamic, complex & resilient
- Flora & fauna representative of other GSL wetlands
- Vary significantly during the year
- Water inflows and water levels are common driver of change
- Nutrient enrichment is of concern but no direct impact observed

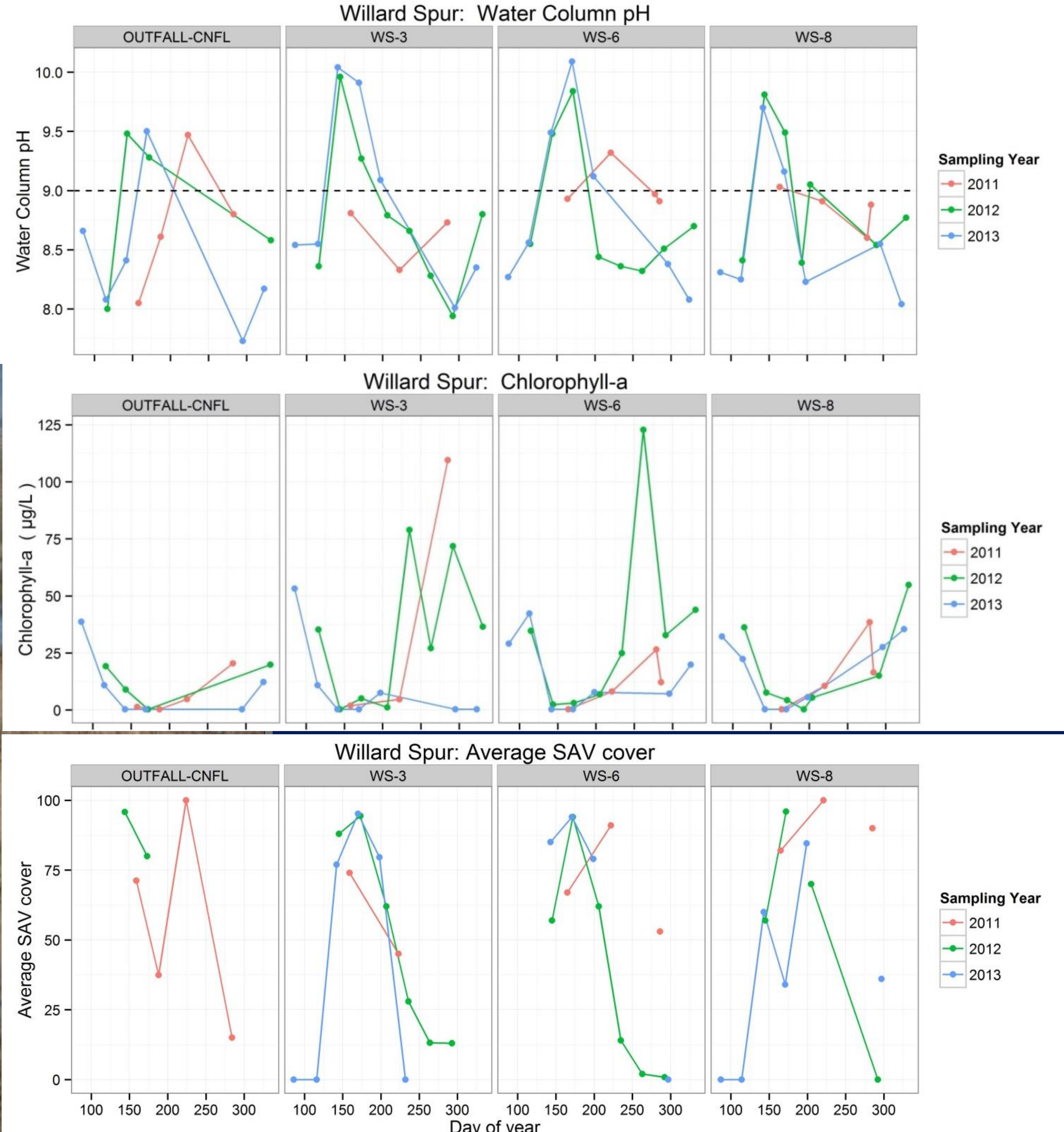
Open Water Characteristics

Key Monitoring Sites: (WS-8, WS-6, WS-3, & OUTFALL-CNFL)

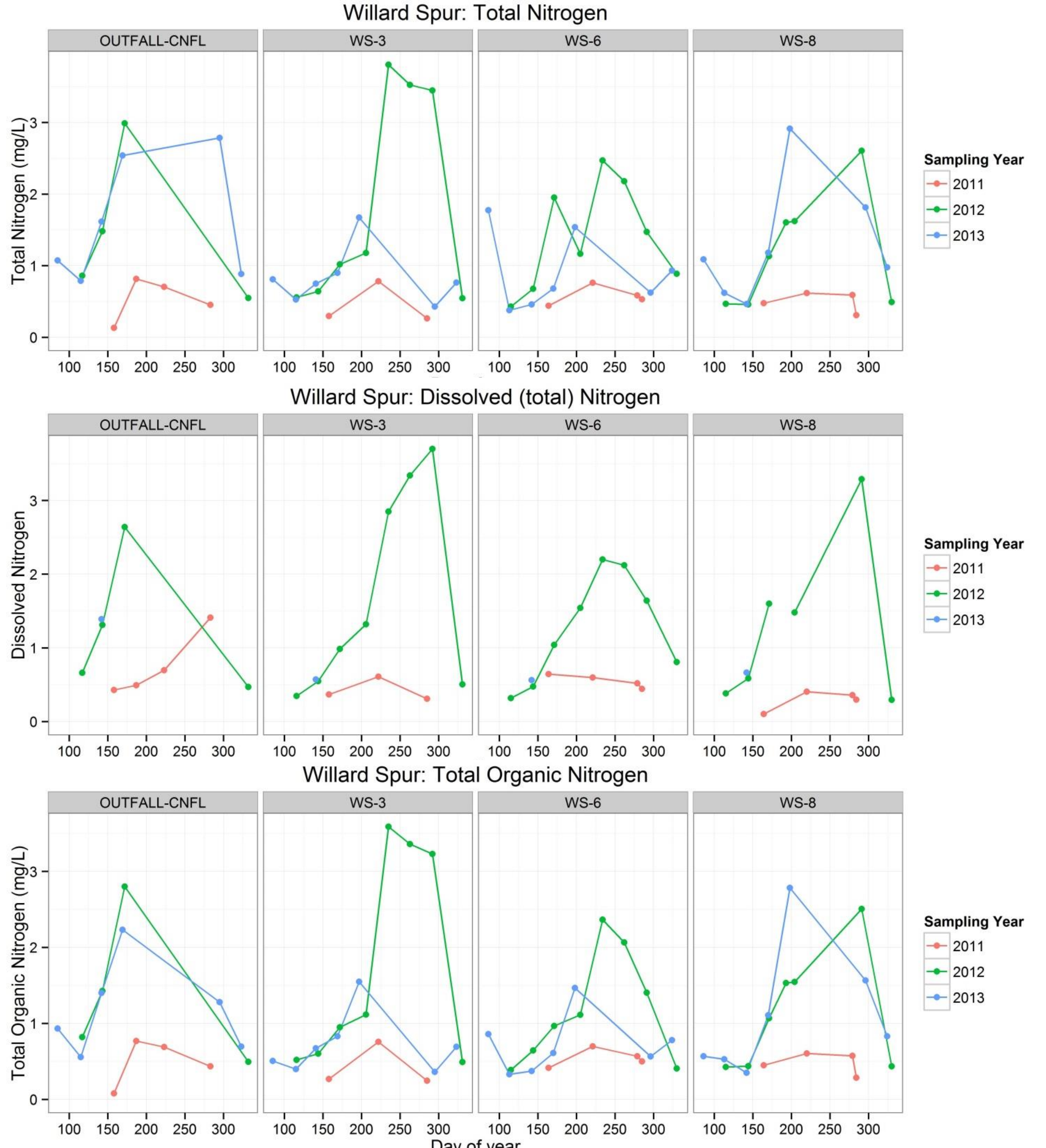




- **Water temperature and salinity increased as depth decreased**

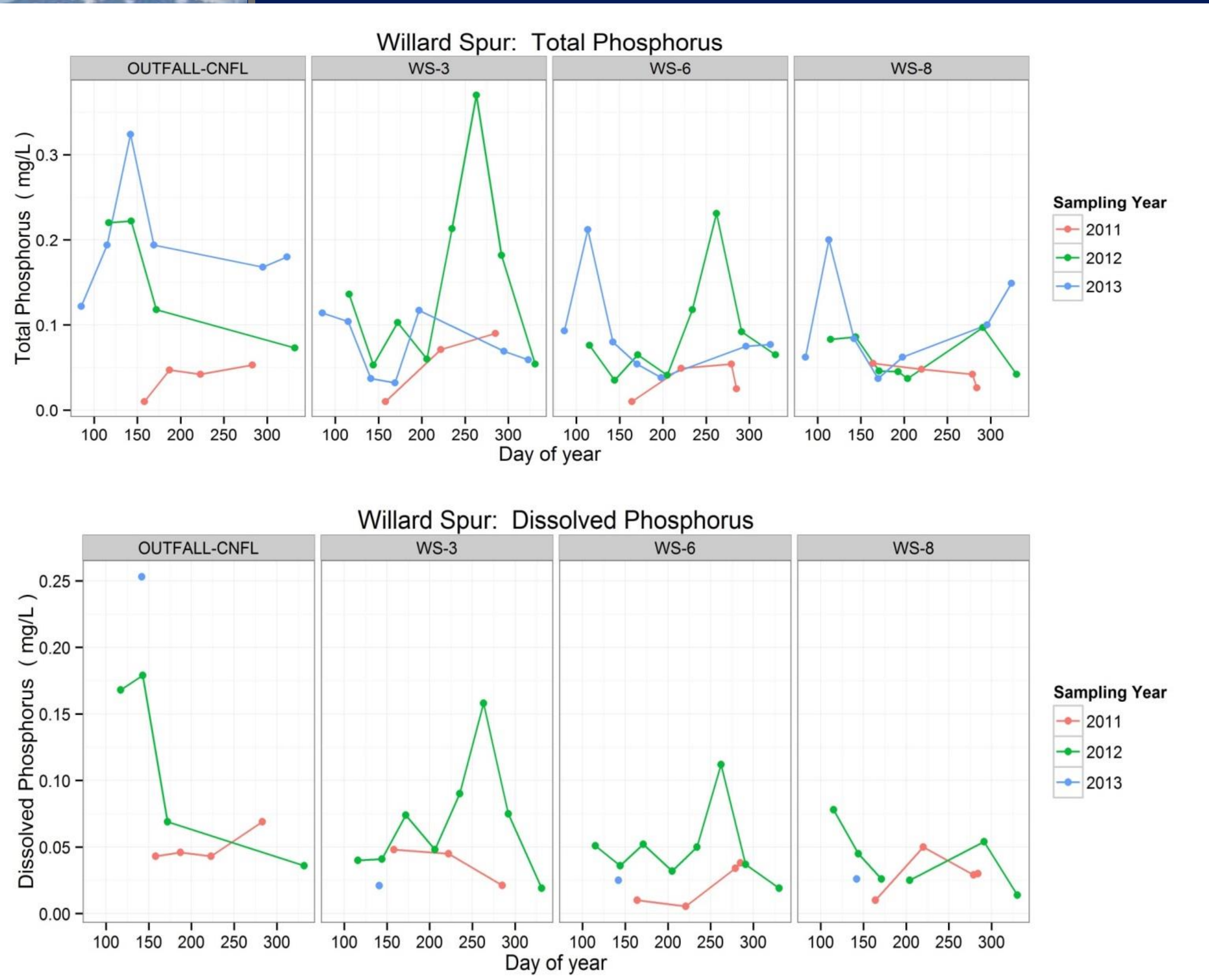


- **pH increased along with SAV cover**
- **Chl-a increased as SAV senesced but was not major driver**



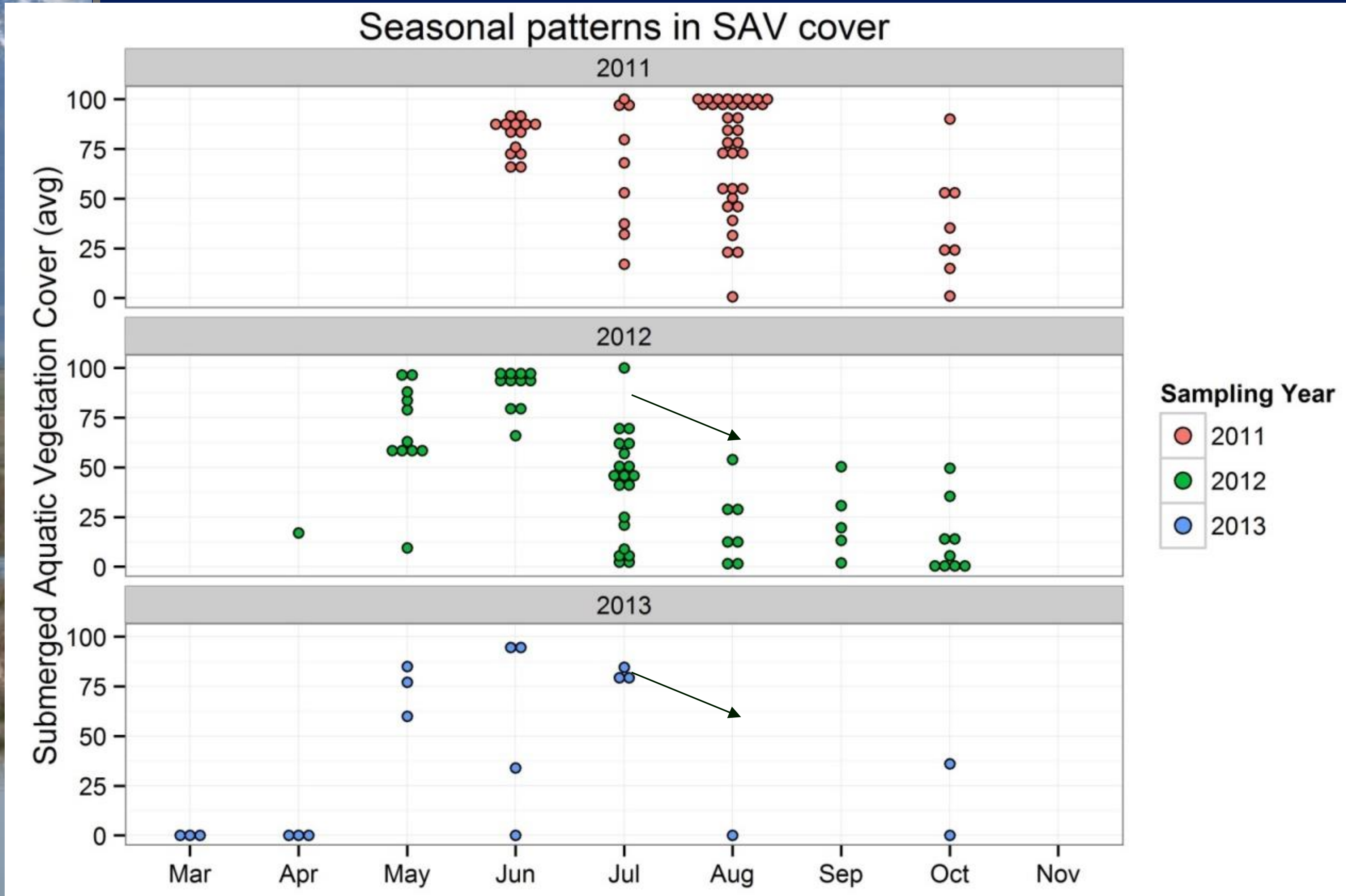
Nitrogen

- Most of TN is dissolved, organic N
- In dry years there is an increase in N that corresponds with SAV senescence



Phosphorus

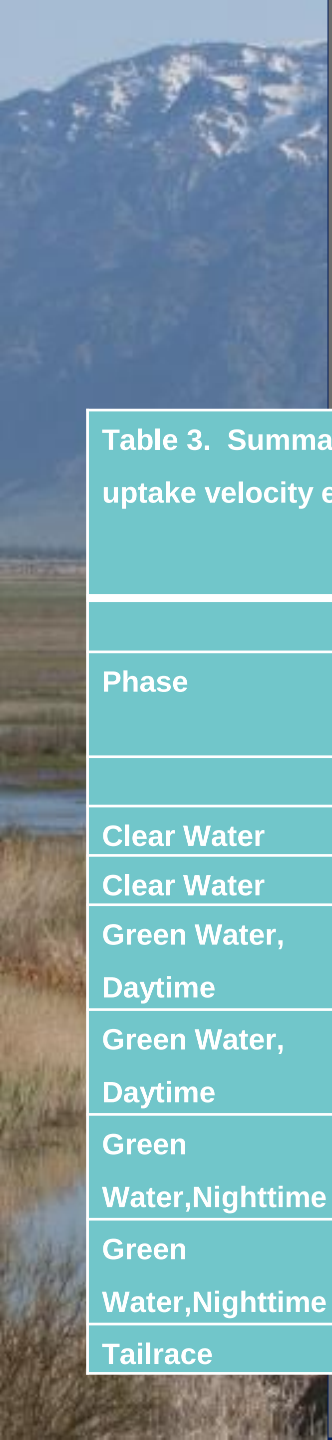
Two peaks: spring and then late in the growing season



Seasonal patterns in SAV cover
2011
2012
2013
Submerged Aquatic Vegetation Cover (avg)
100
75
50
25
0
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Sampling Year
2011
2012
2013

Nutrient Uptake

Assimilative Capacity

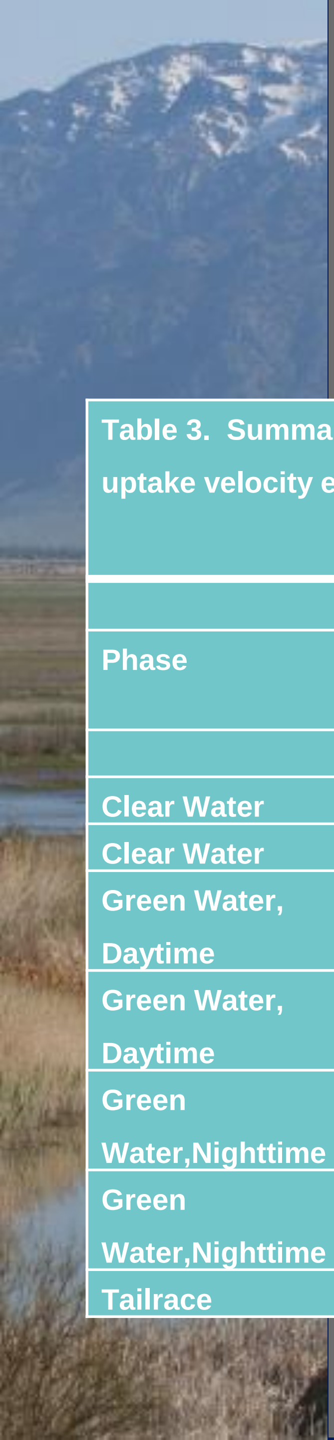


Uptake Summary

Table 3. Summary of experimental conditions for each uptake experiment and uptake velocity estimate for nitrate and phosphate.

			Phosphate		Nitrate	
Phase	Treatment	Volume	Rate Constant	**MRT**	Rate Constant	**MRT**
		m3	/day	**days**	/day	**days**
Clear Water	+SAV	1.24	-0.137	**5.1**	-0.716	**1.0**
Clear Water	-SAV	1.24	-0.054	**13.0**	-0.206	**3.4**
Green Water, Daytime	+SAV	0.14	-0.991	**0.7**	-0.768	**0.9**
Green Water, Daytime	-SAV	0.14	-0.904	**0.8**	-0.999	**0.7**
Green Water,Nighttime	+SAV	0.09	-0.969	**0.7**	-0.978	**0.7**
Green Water,Nighttime	-SAV	0.09	-0.735	**0.9**	-2.25	**0.3**
Tailrace	-SAV	1.74	-0.0995	**7.0**	-0.106	**6.5**

- SAV play a significant role in assimilating nutrients during May - June
- SAV then become a significant source of nutrients as they senesce in July – Sept
- Interestingly, uptake rates were higher in late summer



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- What are the potential consequences of losing SAV?
- Could it become more algae dominated?

Scaling Up - Results

- Does <u>daily</u> uptake exceed daily input (loads)?
  - Worst case, conservative scenario
- How often did daily load exceed assimilative capacity?
  - <u>Nitrate</u>
    - 7.3% (26/352) – All at end of growing season
  - <u>Phosphate</u>
    - 10.7% (38/352) – All early in 2011
- What is the average assimilative capacity?
  - <u>Nitrate</u>: 25,888 lbs.
    - Among days with deficit? **-119 lbs.**
  - <u>Phosphate</u>: 1,791 lbs.
    - Among days with deficit? **-546 lbs.**

Important Conclusions: Uptake

- Current conditions **do not** suggest that the discharge poses a problem
  - **Plenty of assimilative capacity** for most of the growing season, but
  - This is **less true at season end, during dry years**

- Future conditions that might be a concern?
  - **Loss of SAV**
    - Would cause a reduction in assimilative capacity
    - We do not know the cumulative effects of stressors
  - **Loss of hydrologic connection to GSL**
    - Potential for year-to-year increases
  - **Plant at capacity and not addressing nutrients**
    - We did not see a problem, but it was close!